



NOV 16 2016

Putting Safety At the Heart Of Transportation: The Drive Toward Zero-Risk Mobility



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Stories That Matter

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Over the last century there has been a significant increase in demand for travel by all modes. Given all those people crowding onto trains, planes and highways, it is hard to fathom but is highly admirable that the transport industry has in parallel made correspondingly significant improvements in safety. Historically, the big leaps forward in transport safety have been largely reactive, coming in the wake of major accidents and public outcry for increased safety levels.

Being reactive has worked in the past, but it isn't going to work in the future. As safety improves, further improvements become more difficult. The industry and its regulators are going to have to shift towards a more preventative approach, with safety built into transport systems from the start and in a more holistic way.

Some nations are already making the switch. Sweden has adopted a target-based approach known as Vision Zero, that seeks to eliminate highway risk and achieve a 100% safety record in any given year. You read that correctly. Sweden is saying that no loss of life is acceptable, and that notion drives the behaviour and decisions to achieve this. Campaigns like the European Day without a Road Death (EDWARD) initiative (<mailto:http://roadsafetydays.eu>) aiming to achieve zero fatalities in Europe on a given day are important, while recognising that innovative transport technologies are necessary to attain Vision Zero. Practically, this involves planning, designing and building infrastructure to increase safety and reduce fatal accidents.

High-speed rail such as the TGV, Shinkansen and Eurostar is generally considered the safest mode of transportation. Safety figures are exceptional; for the Japanese Shinkansen no passenger has ever been injured or killed in an accident since it commenced operations in 1964. The same applies to the Eurostar service between the UK and France, which has operated since 1994. The reason is that these high-speed rail systems are engineered to be extraordinarily safe. The Shinkansen employs automatic train control to decelerate or halt the train automatically based on conditions of the route ahead and distance to preceding trains. The Shinkansen system is also equipped with an earthquake alarm system that automatically brings trains to a rapid halt when seismic activity is detected.

Every new transport infrastructure project under development today is incorporating some kind of best-in-class safety features into its design. Most of the new road and metro systems are making use of intelligent sensors, autonomous control software, and smart infrastructures. Emerging modes of transportation are well positioned to eliminate risk by incorporating safety at the heart of their organisation from inception, making a Vision Zero-like safety record an operating principle.

We have worked on and studied the safety process for dozens of global clients in the transportation sector, and Hyperloop One as a new “fifth mode” of transportation faces some unique and some familiar transport safety challenges. While there may be no existing precedent for safety available through statistical information and previous data, some first observations on safety risk improvement can be made. People will adopt new technologies only if they perceive them to be safe, both in terms of security of the system and physical safety. People tend to overweigh low-risk probabilities of accident risk and their perception can often differ from reality, notably subjective attitude to objective risk. Communicating the safety risk is a key success factor for Hyperloop, and will need to be managed carefully for all stakeholders from passenger users of the transport mode to those transporting freight and regulators.

In targeting 100% safety, Hyperloop also has some significant advantages over other modes. Being a new mode of transport removes any attachment to legacy systems allowing designers to shape and design safety into the system more effectively by employing the latest advancements in technology. As a new transportation mode, the organisation has the ability to model and control the entire environment as it is a fully enclosed system. Hyperloop is not affected by external factors such as adverse weather conditions or traffic congestion that plague other transport system and networks, neither does it have a negative impact

on the environment (greenhouse gases and noise pollution) as it is a closed system. The autonomous nature of operations means that human error is considerably reduced and in effect the uncertainty element is virtually designed out of the system. Nevertheless, an element of human component still exists in designing the system and infrastructure and this must be controlled.

Taking Safety to New Levels

Hyperloop One can make the Hyperloop the safest mode of transport today and in the future. To do this, Hyperloop One is adopting best practices from around the world such as:

- Taking an overall systems approach (considering all elements both internal and external) to safety in the system design, building the technology and necessary infrastructure to provision a fully operational service.
- Making safety intrinsic in the design, build and operational phases of the overall system and infrastructure that makes it safer and easier. This avoids the step in the development of earlier modes such as rail and air where safety has been reactive in the early stages when speed and comfort took priority over safety.
- Learning from other industry sectors and applying continual innovation to deliver a dynamic safety road map.

Making The Safety Case

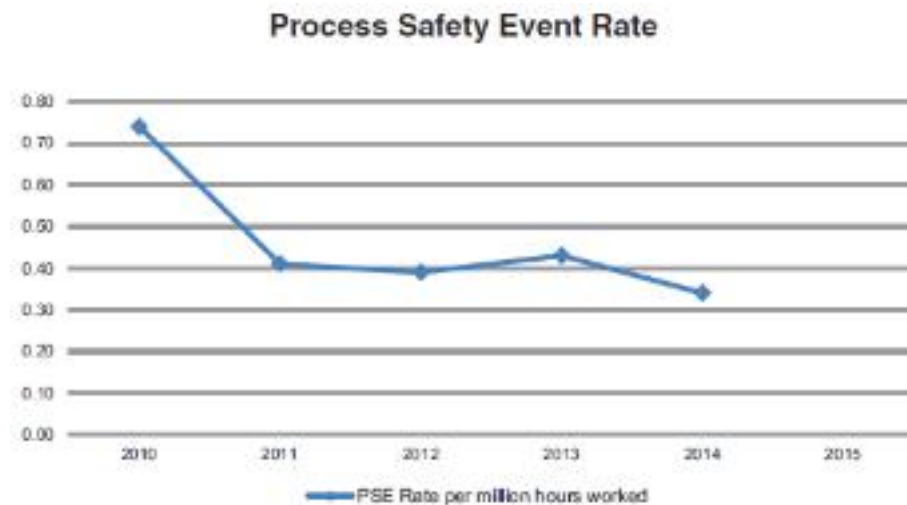
The safety case is not just about designing a safe system. To demonstrate and prove that the system is safe, the methodology to create, operate and maintain the system needs to be robust. In the absence of existing safety standards for a new mode of transport, the Hyperloop One Proof of Operations Facility provides an excellent opportunity for regulators to work collaboratively with the technology developers, systems integrators and safety case experts to define the regulatory regime for an entirely new mode of transport. They understand the importance of being able to help develop safety cases in collaboration with the providers and establish new certification processes. Ultimately this will avoid the lengthy processes of legacy safety certification which would not, in any case, be able to address the safety requirements of a new transport mode. These new processes can also pave the way for rapid, efficient and effective safety case delivery. In doing this, it will still be important for the regulator to maintain an arm's length perspective so that design trade-offs are decided in favour of safety rather than cost.

Tackling Public Perception

Managing the public perception of safety risk is potentially a more difficult challenge.

Disruptive innovations and technologies are naturally associated with perceptions of high risk due to the “fear of the unknown.” Seventy years ago airplanes were commonly perceived as “flying tanks of kerosene.” Now, despite the fact that the assertion is still factually correct, aviation is considered the safest way to travel. This is because of the stringent requirements the industry has forced manufacturers and operators to meet.

Taking a wider view, lessons can also be learned from high hazard industries such as oil and gas extraction, nuclear energy, renewables, chemical and petro chemicals which are highly regulated. The implementation of very high safety standards in these industries has led to a wealth of experience in the design, build and delivery of solutions to their customers. The levels of safety incidents indicated by the UK Petroleum Industries Association (UKPIA) shows that per million hours worked there are marginal safety incidents.



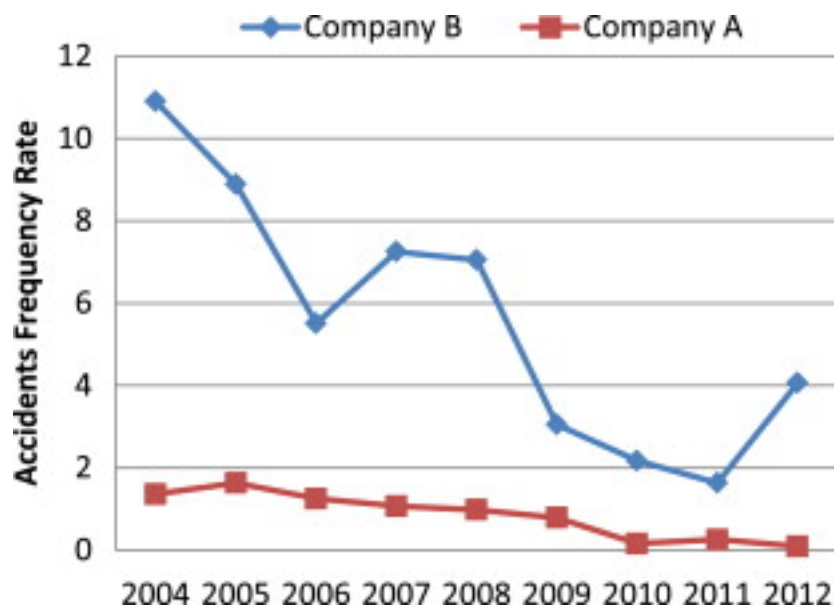
Source: UKPIA

Source: UKPIA Statistical Review 2015 (<mailto:http://www.ukpia.com/docs/default-source/default-document-library/ukpia-2015-statistical-reviewf72b5c889f1367d7a07bff0000a71495.pdf%3Fsfvrsn=0>)

Developing a safety culture

Research findings support the view that a safety culture is associated with fewer accidents compared with organisations that do not take this approach. The rationale is that workers who commit to safety practices, and are rewarded for this as well as other outputs, perform better in reducing occupational accident rates. The comparison below between two petrochemical plants of the same type confirms these results. In the

following example managers of Company A, which is distinguished by the maturity of its safety culture, has significantly higher employee evaluation scores than Company B (Source: Safety Culture Assessment in Petrochemical Industry: A Comparative Study of Two Algerian Plants in Safety and Health at Work 5 (2014) 60-65 (A. Boughaba et al.)



In 2015 Dow Corning was named as the “safest company (mailto:<https://www.dowcorning.com/content/news/EHS-Today.aspx>)” due to its commitment to deliver safety beyond traditional safety metrics (occupational injury and illness rate or process incident rate) to ensure overall safety through its organisation. They deconstructed “What good safety looks like” into operational discipline, risk management, and clarity of expectations. Hyperloop One can enforce, build and further strengthen their safety case using experience from similar industries of these types.

Continuously improve from an already excellent baseline

It will not be enough to implement a system that is the safest mode in the world; safety threats, changing customer expectations, and issues with the system itself will emerge over time so the system will need to improve constantly in a controlled manner to meet these shifts. To be the safest mode in the world Hyperloop One will have to scan the horizon to maintain a view on technologies, capabilities and innovations which can enable it to improve their systems further. Our ability to model complex processes realistically in systems is increasing rapidly and has the potential to be a key tool in decision-making. However we will need to establish a means of quality assurance for those simulations.

Transport systems are increasingly software-based, which provides an opportunity to become safer as they capture more information about the operational system which then can be used to develop an on-going “early warning detection system.” On the other hand this could imply a higher exposure to cyber-attacks

which will require careful consideration. Regular sanity checks will also be needed to complement this approach.

All in all, Hyperloop One has an extensive opportunity to achieve its goal of building the “safest mode of transportation on earth,” so long as it takes to heart the experience and lessons gained by other modes and industry sectors.

Toral Patel is a transport safety expert specialising in quantification of comparative safety risk, analysing risk perceptions and their impact on modal choice. She also investigates how innovative transport technology solutions can address future challenges for transportation.

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